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EARTHQUAKES MAY POSE UNEXPECTED THREAT TO AGRICULTURE

April 2010 Baja California Temblor Did Significant Damage in Imperial Valley

It's been said that earthquakes don't kill people; damaged buildings and falling objects kill people. If that's true, then a farm field would seemingly be a fine place to ride out a major quake.

But what of the fields themselves? A recently released report from the California Geological Survey (CGS) and the U. S. Geological Survey (USGS) about the April 4, 2010 Sierra El Mayor-Cucapah earthquake – a magnitude 7.2 event centered on the Mexican side of the border – concludes that more attention should be given to the potential impact of large quakes on California's biggest industry.

"Every earthquake opens our eyes to some different facet or phenomenon," said State Geologist Dr. John Parrish, head of CGS. "This one has made us ask about the potential impact to and the recovery time of the agricultural industry."

The Sierra El Mayor-Cucapah quake – the largest in that area since 1892 -- caused an estimated $500 million in damage in northern Baja California and an additional $50 million in Imperial County. Two people died and hundreds were injured in Mexico. The quake left an 87-mile surface rupture from the northern tip of the Sea of Cortez northwestward to nearly the U.S. border. Liquefaction – when sandy soil in areas of shallow groundwater levels temporarily behaves like quicksand after intense shaking -- and related quake phenomena damaged buildings, bridges, earthen dams, roadways and especially agricultural lands and infrastructure.

"Mexico is looking at 25,000 hectares (nearly 62,000 acres) of farmland that may never be productive again because of groundwater tainted with salt or other chemicals coming to the surface, or because of subsidence that lowered farmland below the water table or otherwise impacted the irrigation canals and drains," said Tim McCrink of CGS, one of the principle authors of the report. "Water cannot flow uphill, and there were fields of wheat, cotton and alfalfa that were submerged. Levees that contain canals and drainage ditches were damaged. Aside from the fatalities and injuries, this earthquake's biggest impact was on agricultural

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infrastructure."

Added John Tinsley of the USGS, a co-author: "The true value of this report will be realized in the next earthquake that causes widespread liquefaction in the Imperial Valley. The potential impact on water supplies for the region's agriculture and most of the municipalities was dramatically illustrated by the El Mayor-Cucapah earthquake. We cannot count on continuing to be so fortunate in future earthquakes as we were in this event."

The report is officially entitled "Liquefaction and other ground failures in Imperial County, California, from the April 4, 2010 El Mayor-Cucapah Earthquake." It can found online at www.conservation.ca.gov/cgs/information/publications/sr/Documents/SR220_Text_v1.pdf.

"This important study results from the close cooperation between the California Geological Survey and the US Geological Survey following the earthquake," noted Tom Brocher, USGS Earthquake Science Center Director.

California's seismic zoning programs are focused on the urban environment, McCrink noted. The state's Alquist-Priolo program ensures that structures for human occupancy are not built across the traces of surface faults. The Seismic Hazards Zonation Program defines zones where new construction must take into account liquefaction and the potential for earthquake-induced landslides.

"We want to make sure the buildings and infrastructure remain standing," McCrink said. "But food production is important, too."

Added Charles Real, head of the CGS zoning programs, "We've seen damage to rural areas in previous earthquakes, of course, but I'm not aware of any studies or discussions about the implications of widespread damage to the agricultural industry due to earthquakes. It's a very interesting subject to think about, given how important agriculture is to California's economy."

There are thousands of acres of valuable, highly productive California farmland at risk of liquefaction, McCrink pointed out. The San Andreas Fault lies just west of the San Joaquin Valley, and the groundwater is shallow in many areas. Even the Sacramento Valley has some risk, although large earthquakes are not common. The 1892 Vacaville-Winters quake -- estimated to be a magnitude 6.6 -- probably caused liquefaction in local farm fields.

"Eyewitness accounts talk about the ground breaking up and closing again, and large volumes of water spurted up in creek bottoms," McCrink said.

The Sierra El Mayor-Cucapah earthquake was centered in the southern Mexicali Valley. Scientists looked at the impact of both liquefaction and fault rupture (the results of the latter investigations will be released

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separately). The liquefaction report summarizes the effects of the earthquake at 138 sites. Of those, 63 had enough damage to merit mention.

For the most part, Imperial County's farm fields escaped the extensive liquefaction damage seen in the Mexicali Valley on the other side of the border. In California, most of the liquefaction occurred southwest of the city centers of Calexico and El Centro, where the recorded ground motions were highest (60 percent the force of gravity in one location). The report noted that tile drains are common in Imperial County but not in Mexico, and encouraged further study of the mitigating effect of drains.

Although farmland is outside the mandate of the state's seismic hazard mapping program, Real stated that the recent focus on the seismic safety of levees in the Sacramento-San Joaquin Delta points to the potential value of liquefaction hazard maps in some relatively unpopulated areas.

"Given time and resources, we could prepare maps that show where liquefaction might be significant in agricultural areas," he said. "That might be of value to farmers. They might be able to take some precautionary action – strengthening levees, for example. And if they found that tile drains minimized the effects of liquefaction in some areas, susceptibility maps might indicate where to use them to limit damage."

McCrink said Imperial County "dodged several bullets" because the epicenter was 30 miles south of the border.

"Had the same earthquake occurred on one of several faults north of the border – the Imperial, the San Jacinto or the southern San Andreas – the county would have been hurt a lot worse," he said.

Imperial County also dodged a bullet in 1940. A magnitude 7.1 quake on the Imperial Fault killed nine people and was felt as far away as Tucson, Arizona. It displaced the All American Canal levees by 15 feet, but the canal was still under construction and not yet transporting water. The report states that a repeat of that quake could cut off the water supply to the many area communities and the agricultural industry that supports them.

"We need to be aware that this type of quake will happen again in that area, and hopefully it won't be as bad as it could be – again," McCrink said.

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